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SUBJECT: SUBMITTAL OF RECOMMENDED COURSE OF ACTION FOR THE OLD SEWAGE BASIN (NRF-21A)

Reference: (a) Phase I Remedial Design Report/Remedial Action Work Plan, Operable Unit 8-08 dated September 1999
(b) Final Record of Decision, Naval Reactors Facility, Operable Unit 8-08 dated September 30, 1998

This letter forwards a recommended course of action to address the increased scope of remedial actions at the Old Sewage Basin, which is a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site at the Naval Reactors Facility (NRF).

Remedial actions at the Old Sewage Basin (NRF-21A) began in June 2000. A concrete pipe leading to the basin was excavated and removed, and remediation of the soil within the basin was initiated. The excavation was suspended in November 2000 for the winter. In the summer of 2001, exploratory trenches were dug to help better define the boundary of the basin requiring remedial actions. These exploratory trenches showed the basin area requiring remediation was significantly greater than planned in the Phase I Remedial Design/Remedial Action (RD/RA) Work Plan, reference (a).

Based on the information obtained from the exploratory trenches, the remedial actions at NRF-21A needed to be reassessed. The attachment provides the assessment and rationale for the recommended course of action. In summary, the assessment recommends that the remedial action at NRF-21A be modified from excavating soil above CERCLA cleanup levels to constructing an engineered cover over the site.

This modification to the selected remedial action will require an Explanation of Significant Difference (ESD) to the NRF Final Record of Decision (ROD), reference (b), and subsequently public notification. The ESD will be forwarded to the Idaho Department of Environmental Quality and the Environmental Protection Agency at a later date based on concurrence for the recommended course of action.

Please call Anthony S. Dull of my staff at 208-533-5755 if you have any questions or require additional information.

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## Background

The Old Sewage Basin (NRF-21A) is located southeast of the NRF perimeter fence. The basin was constructed in 1956. Drafting blueprints from 1956 show the basin as an open pond area 72 feet by 72 feet by 11 feet deep (see Figure 1). The basin was cross-contaminated by the radiological discharge system in 1956. The basin was enlarged in 1957 (Figure 2 shows the expanded basin from a distance). The basin was used until 1960; some time later it was filled in with soil and a small mound of soil approximately 3 feet high was created over the basin area. Recent information indicates that the basin was filled with material (soil and lava rock) from the S5G construction project (Figure 3 shows overhead view of the filled-in basin).

In 1991, samples were collected to a depth of 20 feet in a location that appeared to be outside the original basin area, but within the expanded basin area (Figure 4 shows approximate location of various samples). The maximum radioactivity detected was 0.13 picocuries per gram (pCi/g) of cobalt-60 (Co-60) and 0.18 pCi/g of cesium-137 (Cs-137). An additional borehole was sampled approximately 320 feet southeast of the first sample location. This was outside the expanded basin area and samples were collected to only a 5 foot depth; trace amounts of Cs-137 and Co-60 were detected.

During the Remedial Investigation (RI) in 1996, samples were collected from two different boreholes. The first borehole was near the expected discharge point to the basin. Contamination (up to 229 pCi/g Cs-137) was encountered at the 14 foot depth (approximately 11 feet below natural grade). The second borehole was approximately 170 feet from the first hole and was in the expanded portion of the basin. The second borehole was also 14 feet deep, but contamination was not encountered at this location.

## Discussion

Based on the samples collected in 1991 and 1996, it was hypothesized that just the original basin area was potentially contaminated with radioactivity. A Record of Decision (ROD) was signed in 1998 that specified the remedial action at the Old Sewage Basin (NRF-21A), which included excavating the contaminated soil greater than cleanup levels, consolidating the soil in the S1W Leaching Beds, and backfilling the area to surrounding grade level. The Phase I Remedial Design/Remedial Action (RD/RA-I) Work Plan stated that contaminated soil would be excavated at NRF-21A to a minimum depth of 14 feet, which was identified as a remediation goal. This corresponds to the depth contamination was found during the RI and represents an 11 foot depth below natural grade. The remainder of the CERCLA sites with remedial actions specified a minimum depth of 10 feet, which corresponds to the maximum depth a resident would excavate when building a home.

The primary contaminant of concern at NRF-21A is Cs-137. Small levels of Co-60, nickel-63 (Ni-63), and strontium-90 (Sr-90) were detected but at levels below cleanup levels. Elevated levels of metals were also detected during RI sampling in 1996, but were either below risk-based concentrations or were not considered contaminants of concern based on risk management decisions.

The ROD and the Proposed Plan did not specify a depth for excavation. The risk assessment scenarios evaluated a potential resident or occupational worker being exposed to contaminants in the top ten feet of soil through various exposure pathways. The 100-year residential scenario is the scenario of concern, with the external exposure to radioactivity through intrusion being the primary pathway of concern. The RD/RA-I Work Plan supported the option of excavating to only a ten foot depth at most of the remedial action sites, with institutional controls for any areas not fully remediated to the cleanup goals. However, NRF had planned to excavate all soil greater

than cleanup levels if it was fiscally and technically feasible, to support unrestricted release within 100 years of as much area as practical.

Remedial actions began at NRF-21A in June 2000. Contaminated soil was found along the length of the 10 inch concrete pipe leading to the basin. The pipe and associated contaminated soil from the outer NRF security fence to the basin were removed. The cistern, or distribution pipe, at the inlet to the basin was also removed. The bottom of the cistern was approximately 11 feet below natural grade. After removing the cistern, excavation began on the remainder of the original basin. A several inch layer of sludge-like material was found near the cistern that was contaminated higher than surrounding soil. The northwest and northeast edge of the original basin area was located during excavation. Contamination was approximately 2 feet thick in these areas and was generally first encountered at the 5 to 6 foot depth (relative to natural grade), although there were a few locations where contamination was found at the 4 foot depth. The entire northwest edge of the basin was located and is approximately 80 feet long. The southeast side of the basin was not located during the initial excavation.

Approximately 22,300 $ft^3$ of contaminated soil was removed at NRF-21A during the year 2000 field season. This is significantly more than the original 10,400 $ft^3$ estimated, and a large portion had come from along the pipe where contamination was not expected. A revised contaminated soil volume estimate was calculated for a proposal to increase the capacity at the S1W Leaching Beds where the soil is consolidated. The revised estimate showed a maximum of 19,200 $ft^3$ remaining in the basin area, assuming the entire original basin area (an 80 foot by 80 foot area was assumed) was contaminated to a 3 foot thickness.

Samples of the soil near the cistern that showed some of the highest radioactivity were collected and sent to the off-site laboratory for analysis of metals, semi-volatile organics, and volatile organics. The metal results were typically either less than the levels detected during the RI sampling in 1996 or below background concentrations. Small amounts of organics were detected, but were below any risk-based concentrations. This sampling showed that Cs-137 remained the primary contaminant of concern at NRF-21A.

The table below compares the sample results from the RI to those collected during excavation and exploratory trenching (for obtaining information as discussed later in the text) at NRF-21A. The result from one of the samples collected for off-site radionuclide analysis was the highest radioactive sample result detected during the excavation. This provides a very conservative comparison to risk-based concentrations, background concentrations, and the RI sample results.

The excavation at NRF-21A was suspended for the winter in November 2000. Remedial actions at NRF-21A resumed briefly in April 2001. Work delays associated with non-CERCLA tasks caused a two month delay. In order to determine if this delay could be made up, the scope of the excavation at NRF-21A needed to be better defined. Since the eastern end of the basin had not been located, a test trench east of the expected end of the original basin was excavated (Trench 1 Location on Figure 4). Prior to excavating the trench, the mounded soil in the trench area was removed. The trench started in an area known to be outside the basin and was excavated to the maximum reach of the backhoe (approximately a 15 foot depth). The trench continued toward the basin until surveys and visual inspections indicated the edge of the basin was encountered. Contaminated soil greater than cleanup levels was encountered at the 8 foot depth. Visual inspection of the exposed soil showed a defined line angling downward, toward the bottom of the expanded basin, with backfill above the line and contaminated natural soil below the line. This indicated that the contamination was not confined to the original basin area and had spread to the expanded portion of the basin. It therefore appeared the scope of the NRF-21A remedial excavation may have increased greatly.

| Constituent | RI Sampling | Remediation Sampling | Background[a] | Risk-based Concentration[b] | Notes |
|---|---|---|---|---|---|
| **Organics (ppm)** | | | | | |
| Methylene chloride | ND | 0.0018 J | NA | 8.5 | Detected at level less than risk-based concentration. |
| Ethybenzene | ND | 0.00024 J | NA | 780 | Detected at level less than risk-based concentration. |
| Xylenes (total) | ND | 0.00054 J | NA | 16000 | Detected at level less than risk-based concentration. |
| 2-Chlorotoluene | ND | 0.00036 J | NA | 160 | Detected at level less than risk-based concentration. |
| 4-Chlorotoluene | ND | 0.00035 J | NA | 160[c] | Detected at level less than risk-based concentration. |
| 1,3 – Dichlorobenzene | ND | 0.00036 J | NA | 700 | Detected at level less than risk-based concentration. |
| 1,4 – Dichlorobenzene | ND | 0.00048 J | NA | 2.7 | Detected at level less than risk-based concentration. |
| Bis(2-Ethyhexyl)phthalate | ND | 0.314 | NA | 4.6 | Detected at level less than risk-based concentration. |
| **Inorganics (ppm)** | | | | | |
| Aluminum | 5500 | 13600 | 24000 | 7800 | Detected below background level. |
| Antimony | 180 J | 0.736 J | 7.4 | 3.1 | Detected below background level. |
| Arsenic | 4.73 | 8.83 | 7.4 | 2.3/0.037[d] | Not a contaminant of concern at NRF as explained in RI. |
| Barium | 160 J | 230 | 440 | 550 | Detected below background level. |
| Beryllium | 0.36 | 0.702 | 3.0 | 0.015 | Detected below background level. |
| Cadmium | 13.0 | 0.825 | 3.7 | 3.9 | Detected below background level. |
| Chromium | 1000 J | 38.6 | 50 | 39 | Detected below background level. |
| Copper | 240 | 26.8 | 32 | 290 | Detected below background level. |
| Iron | 11600 | 18700 | 35000 | NA | Detected below background level. |
| Lead | 150 J | 16.4 | 23 | 400 | Detected below background level. |
| Manganese | 210 | 358 | 700 | 39 | Detected below background level. |
| Mercury | 10 J | 0.716 | 0.074 | 2.3 | Detected at level less than risk-based concentration. |
| Nickel | 24 | 28.4 | 55 | 160 | Detected below background level. |
| Silver | 55 | 25.2 | ND | 39 | Detected at level less than risk-based concentration. |
| Sodium | 210 | 295 | 520 | NA | Detected below background level. |
| Zinc | 800 J | 103 | 220 | 2300 | Detected below background level. |
| **Radionuclides (pCi/g)** | | | | | |
| Actinium-228 | 1.1 | 2.78 | 2.1 | | Naturally occurring; no known process release. |
| Bismuth-214 | 1.1 | 1.95 | 1.85 | | Naturally occurring; no known process release. |
| Cesium-137 | 229 | 26800 | 1.28 | 0.003 | Contaminant of Concern detected above risk-based concentration. |
| Cobalt-60 | 2.6 | 136 | NA | 0.019 | Not a contaminant of concern because of short ½ life. |
| Lead-212 | 1.8 | 2.96 | 2.1 | | Naturally occurring; no known process release. |
| Lead-214 | 1.35 | 2.98 | 1.85 | | Naturally occurring; no known process release. |
| Nickel-63 | 7.74 | 116 | NA | 177 | Detected at level less than risk-based concentration. |
| Potassium-40 | 26.6 | 46.2 | 32 | | Naturally occurring; no known process release. |
| Radium-228 | ND | 2.78 | 0.38 | | Naturally occurring; no known process release. |
| Strontium-90 | 2.02 | 6.5 | 0.76 | 2.92 | Detected at level below CERCLA cleanup level (45.6 pCi/g). |
| Thallium-208 | 0.34 | 0.626 | 0.74 | | Naturally occurring; no known process release. |
| Thorium-230 | 1.39 | 1.95 | 1.88 | | Naturally occurring; no known process release. |

(a) Background levels were obtained from "Background Dose Equivalent Rates and Surficial Soil Metal and Radionuclide Concentrations for the Idaho National Engineering Laboratory", INEL-94/0250, August 1996, Revision 1, Tables 22 and 24 – Upper 95% Tolerance Limits with 95% Confidence for Grab Samples.

(b) Risk-based concentrations were obtained from the information presented in Appendix F of the Comprehensive Remedial Investigation and Feasibility Study Final Work Plan Waste Area Group 8. Screening levels were based on a $1 \times 10^{-7}$ risk (carcinogen) or a 0.1 hazard quotient (non-carcinogen).

(c) Risk-based concentration was not listed. Value shown is for 2-Chlorotoluene.

(d) Non-carcinogenic risk-based concentration shown first.

NA – Not applicable

ND – Not detected

J – Estimated value

Since the end of the expanded basin was fairly well established by the existing fencing and mounded area, another trench (Location 2 on Figure 4) along the southeast edge was excavated in the same manner discussed above. Again, contamination greater than cleanup levels was encountered at the 8 foot depth. A third trench (Location 3 on Figure 4) was excavated along the southwest side of the expanded portion of the basin and contamination was again encountered at the 8 foot depth. These trenches provided information on the extent of the basin perimeter and confirmed that the scope of the NRF-21A remedial action had significantly increased.

The third exploratory trench was continued until near the middle of the expanded portion of the basin to help define the location of the bottom of the basin in this area. This trench was also used to determine the contamination thickness along the bottom. The contamination was generally first encountered at the 10 to 11 foot depth in the expanded basin. The thickness of the contamination was determined to be about 1-1/2 to 2 feet. The expanded basin bottom was not well defined like the basin sides had been, and did not appear to be a uniform flat surface, but rather an undulating surface such as that created by excavation equipment (i.e., bulldozer, front-end loader, etc.)

A fourth trench was excavated in the middle of the original basin to help determine the depth of the basin and the thickness of contamination (Trench 4 Location on Figure 4). Contaminated soil was encountered at the 11 to 12 foot depth and had a thickness of approximately 2 feet. Approximately 1000 $ft^3$ of contaminated soil was removed during the trenching activities, resulting in a total amount of 23,500 $ft^3$ excavated to date.

The exploratory trenches encountered large lava rock backfill and roofing debris with nonfriable asbestos-bearing material. The lava rock was found in the second and third trenches within the expanded basin. The rock is suspected to be from excavation to support the construction of the S5G prototype, which occurred at approximately the same time the basin was filled in. The roofing debris was only within the 3 foot mound over the basins where other construction debris was encountered.

The sides of the expanded basin appear to have a more gradual slope than the sides encountered during excavation along the original basin. The slope along the sides of the original basin are approximately 45 degrees, while the slope along the sides of the expanded part of the basin were more like 20 to 30 degrees.

## Evaluation

Based on the three exploratory trenches in the expanded basin, contamination started along the edge at approximately the 8 foot depth (relative to natural grade level). All three trenches showed the sloped edge of the basin wall, with backfill material above the slope and natural material below the slope. The width of the expanded portion of the basin is approximately 70 to 80 feet. Figure 5 shows photos of the trench areas.

In the original portion of the basin, contamination is generally first encountered at the 5 to 6 foot depth along the edge of the basin, and at 11 to 12 feet deep in the center (which corresponds to the bottom of the cistern). Initial cleanup in the cistern area showed contamination above cleanup levels present down to the 15 foot depth (18 foot depth from top of mounded area). The thickness of the contamination is greater near the cistern area (3 to 4 feet thick) than in the rest of the basin (approximately 2 feet thick).

If the bottom of both the original and expanded portions of the basin is approximately 11 feet deep, as the trenching indicates, this could explain why the second borehole from the remedial

investigation did not encounter any contamination. That borehole was augered to the 14 foot depth, including the mounded area; if the mound was slightly higher than 3 feet at this location, the borehole may not have reached 11 feet below grade, and contamination may have been deeper than the augered depth. An engineering survey performed during the remedial investigation showed the elevation of the second borehole being approximately 1.5 feet higher than the first borehole.

This does not explain why the 20 foot deep borehole from 1991 did not encounter contaminated soil. Figure 4 shows that this borehole should have been within the expanded portion of the basin. An inadequate sample method may have been employed for retrieving soil samples (i.e., mixing of soils, poor recovery, etc.).

Based on the information obtained from the trenches and excavation, the total length of contamination present at NRF-21A above cleanup levels is approximately 340 feet, with a 70 to 80 foot width. Samples collected from the excavation area show Cs-137 remains the primary contaminant of concern. The contamination along the sides of the basin is approximately 2 feet thick. The thickness of the contamination at the bottom of the basin varies from 1-1/2 to 2 feet in the expanded basin area, to approximately 4 feet near the cistern. The depth to reach contamination along the edge of the expanded portion of the basin is deeper than in the original basin. The surface water elevation prior to expanding the basin was likely higher than the elevation after the expansion. This may explain why the contamination along the perimeter is lower (deeper) in the expanded basin.

In summary, depth to contamination around the edges is generally 5 to 6 feet in the original basin, and about 8 feet in the expanded basin. Depth to contamination is about 11 to 12 feet in the center of original basin and 10 to 11 feet in the center of the expanded basin. Average thickness is about 2 feet everywhere except near the cistern, where it was about 4 feet (most of which has been removed). All depths are relative to natural grade. The mound over the basin is about 3 feet high with some areas being closer to 5 feet. See Figure 6 for a cross-sectional view of the basin.

The additional data obtained during excavation and trenching has little effect on the conclusions of the risk assessment performed for NRF-21A in the RI. A very conservative risk assessment was performed during the RI for NRF-21A. The assessment assumed maximum contaminant concentrations were present for the entire depth of the basin (14 feet thickness). The risk assessment concluded that Cs-137 was the only contaminant of concern at NRF-21A. The recently collected metals and organic data, as shown on a previous table, were below background or risk-based concentrations used to screen constituents during the RI, or (for arsenic) previously evaluated in the RI as not being a contaminant of concern. Most of the radionuclides detected were naturally occurring with no known process release at NRF. Cs-137, Co-60, Ni-63, and Sr-90 were detected at elevated levels; however, Ni-63 was below its risk-based concentration, Sr-90 was below its remediation goal, and Co-60, with its short half-life, does not have a remediation goal.

Since the basin area is considerably larger than expected and Cs-137, Co-60, Ni-63, and Sr-90 were detected at higher levels than seen during the RI sampling, the groundwater pathway for these constituents was reassessed to ensure there is no significant risk via the groundwater pathway. The GWSCREEN modeling program, which was used during the RI risk assessment, was used to assess the constituents. The following table provides the parameters used in the program. The resulting peak concentration and peak time show the risk via the groundwater to be very low.

| Constituent | Soil Concentration[a] (pCi/g) | Activity[b] (Ci) | $K_D$[c] | Peak Concentration in Groundwater (mg/l or pCi/L) | Peak Time (years) | Risk |
|---|---|---|---|---|---|---|
| Cs-137 | 26,800 | 99.7 | 500 | 2.41E-226 | 162220 | Very Low |
| Co-60 | 136 | 0.52 | 10 | 9.84E-198 | 3264 | Very Low |
| Ni-63 | 116 | 0.43 | 100 | 3.16E-110 | 32595 | Very Low |
| Sr-90 | 6.5 | 0.024 | 24 | 4.98E-94 | 7838 | Very Low |

(a) Maximum observed
(b) Activity present assuming maximum concentration for entire soil volume
(c) Distribution Coefficient (higher $K_d$ represents slower migration potential in soils)

## Options

Because the scope of the work effort at NRF-21A has increased, it is appropriate to reevaluate the remedial action options available at NRF-21A. There appear to be three options available for NRF 21A, with one option having three potential variations. These options are: (1) continue to excavate at NRF-21A, (2) suspend excavating and construct a cover over the area, and (3) fill in the excavation and implement institutional controls (no action alternative). Regardless of the option chosen for the basin at NRF-21A, the remainder of the basin pipe, within the NRF security fence to the L-shaped sump, will be removed and the soil remediated. As discussed previously with the agencies, this portion of the pipe will be removed later when until other pipes associated with CERCLA sites NRF-12A and NRF-11 are removed, because of the difficulty in excavating between the security fences.

## Option 1

Option 1 includes three variations or suboptions. These are: (a) excavate all the contaminated soil above cleanup levels regardless of depth, (b) excavate to the minimum depth (14 feet including the 3 foot mound area; 11 feet below natural grade) specified in the RD/RA-I Work Plan as the remediation goal, and (c) excavate to the 10 foot depth specified as a minimum in the Work Plan for the other CERCLA sites.

For each suboption, an estimate of the area and volume of contaminated soil greater than cleanup levels is needed. The following assumptions are made based on the current excavation and the exploratory trenches:

(1) The length of the basin is 340 feet, which includes 100 feet of the original basin and 240 feet for the expanded portion of the basin.
(2) The basin width is 80 feet.
(3) Contamination starts at the 5 to 6 foot depth in the original basin.
(4) Contamination starts at the 8 foot depth in the expanded part of basin.
(5) The original basin bottom is 11 to 12 feet deep.
(6) The expanded basin bottom is 10 to 11 feet deep.
(7) The thickness of the contamination along the sides and bottom of the basin is 2 feet (3 feet is used for estimating purposes since, when excavating the basin, it is difficult to separate the clean soil from the contaminated soil within ½ foot of the contamination).
(8) The thickness of the contamination near the cistern is closer to 4 feet; however, a portion of this has been cleaned up, so this thickness is not used when estimating soil volume.
(9) Although some cleanup has been performed, it is assumed the entire basin is still contaminated; confirmatory samples have not been collected in those areas where contaminated soil has been removed.

Option 1a

Option 1a would entail continuing excavation of the contaminated soil in the basin regardless of depth. The amount of contaminated soil to be excavated would be 81,600 $ft^3$ (340 feet long by 80 feet wide by 3 feet deep). Adding the amount expected from the remaining pipe excavation between the security fences and leading to the L-shaped sump (estimated at 10,500 $ft^3$) makes a total amount of 92,100 $ft^3$ of contaminated soil yet to be excavated. This represents approximately 460 additional soft-sided containers (SSCs). To date, 23,300 $ft^3$ of contaminated soil has been excavated. The total amount of contaminated soil to be excavated, including what has already been excavated at NRF-21A, would be 115,400 $ft^3$, which is greater than 11 times the estimate in the RD/RA-I Work Plan. The total amount of clean and contaminated soil to be excavated with this option is greater than 600,000 $ft^3$.

The cost per SSC at the CERCLA excavation sites to date has been approximately $7,450. This cost is inclusive of all tasks being preformed by the subcontractor, including: engineering, sampling, setup costs, material purchase, excavating clean and contaminated soil, filling and moving SSCs. etc. The 460 SSCs would represent an estimated remaining cost of $3,427,000. Approximately $513,000 has been spent to date (through last year's field season). The total estimated cost for NRF-21A under this suboption is therefore $3,940,000. The original estimated cost for NRF-21A was $705,000. If this option is selected, the time required to complete the effort at NRF-21A would be extended at least a year beyond the RD/RA-I completion goal of November 30, 2001.

The cost variance for this suboption would require public notification per an Explanation of Significant Difference (ESD), since the overall cost for the Operable Unit 8-08 remedial actions will have increased 52% above the cost estimate provided in the ROD. This cost increase does not include the potential additional costs associated with exceeding the current capacity at the S1W Leaching Bed area. The number of SSCs generated would likely exceed the capacity at the S1W Leaching Beds where the SSCs are placed (this depends on the number of SSCs generated at the other CERCLA sites). The capacity area of the leaching beds could be expanded; however, this would place the SSCs in an area outside the current contamination zone near the beds and would somewhat increase the size/cost of the engineered cover for that area. Another option for the SSCs would be to send the SSCs to an INEEL soil repository (being established at the Idaho Nuclear Technology and Engineering Center (INTEC)) or to a commercial disposal facility. This would increase the cost since (a) additional soil sampling would be required for characterization and certification of shipments, and (b) additional handling and transportation would be required. The ROD estimated the additional costs for off-NRF disposal to be between $100 and $400 per cubic yard (based on using an INEEL facility or commercial facility). The INTEC CERCLA repository may not be available for several years.

As for all NRF CERCLA sites being cleaned up to this standard, minimal institutional controls would be required for residual contamination that is present below cleanup levels. The institutional controls would be needed for a maximum of 100 years, after which the area would be acceptable for unrestricted release.

The primary advantage of this option is that the subcontractor is set up and prepared to excavate to the required depth. This option would meet the remediation goal in the RD/RA-I Work Plan. The disadvantages of this option include the cost, additional modifications likely required at the S1W Leaching Bed area, and extending the schedule to complete NRF-21A, which would likely impact the completion date for other CERCLA work and put the July 31, 2003 completion date for the Phase 1 remedial actions in jeopardy. The increased cost associated with this option would require public notification through an ESD to the ROD. If the S1W

Leaching Bed area is not to be expanded, additional delays may be associated with shipping the SSCs elsewhere for disposal.

Option 1b

Option 1b would include excavating contaminated soil greater than cleanup levels to the minimum depth specified as the remediation goal in the Work Plan. This depth is 14 feet, which includes the 3 foot mounded area, or 11 feet below natural grade level. Since the bottom of the expanded part of the basin may be near the 10 foot depth, some contaminated soil along the bottom from this part of the basin may need to be excavated. This option requires an estimate of the width of each side of the basin that would be excavated to the 11 foot depth. Assuming the basin bottom is approximately 50 feet wide (based on the existing blueprints of the original basin), this would make the width of the sides about 15 feet (50 feet + 15 feet + 15 feet = 80 foot estimated width). However, field observations from the current excavation tend to show the side slope is more gradual than expected, and therefore a better estimate is 20 feet for each side of the basin.

The estimated volume of contaminated soil to be removed in this option is 60,000 $ft^3$. This assumes a 20 foot width of contamination along the sides of the basin, with a 3 foot depth, and assumes that approximately one foot of soil from the bottom of the expanded basin would be removed. Adding the amount expected from the remaining pipe excavation between the security fences and leading to the L-shaped sump (estimated at 10,500 $ft^3$) makes a total amount of 70,500 $ft^3$ of contaminated soil yet to be excavated. This represents approximately 353 additional soft-sided containers (SSCs). To date, 23,300 $ft^3$ of contaminated soil has been excavated. The total amount of contaminated soil to be excavated, including what has already been excavated at NRF-21A, would be 93,800 $ft^3$, which is 9 times the estimate in the RD/RA-I Work Plan. The total amount of clean and contaminated soil to be excavated with this option is greater than 400,000 $ft^3$.

Considering the cost per SSC, the 353 SSCs would represent an estimated remaining cost of $2,630,000. The total estimated cost for NRF-21A under this suboption, including work performed to date, is therefore $3,143,000. The original estimated cost for NRF-21A was $705,000. Although this option requires less soil to be excavated than Option 1a, many of the same issues exist with this option. If this option is selected, the time required to complete the effort at NRF-21A would be extended at least a year beyond the RD/RA-I completion goal of November 30, 2001.

The cost variance for this suboption would likely require public notification per an ESD, since the overall cost for the Operable Unit 8-08 remedial actions will have increased 43% of the cost estimate provided in the ROD. This cost increase does not include the potential additional costs associated with exceeding the current SSC capacity at the S1W Leaching Bed area, as discussed above for suboption 1a.

Once cleanup actions are completed using this option, institutional controls would be required for contamination that exceeds the cleanup levels below the 11 foot depth, as well as the residual contamination within the cleanup goals that remains above the 11 foot depth. Some institutional controls, such as restrictions on soil disturbances below the 11 foot depth (i.e., drilling a well), would be needed well beyond 100 years.

The advantages and disadvantages of this option are similar to Option 1a, except the amount of soil removed would be less, which would result in less cost and time delays during remedial actions. The primary advantage of this option is that the subcontractor is set up and prepared to excavate to the required depth. This option would meet the remediation goal in the RD/RA-I

Work Plan. The disadvantages of this option, as with Option 1a, include total cost, and extending the schedule to complete NRF-21A, which would likely impact the completion date for other CERCLA work and put the July 31, 2003 completion date for the Phase 1 remedial actions in jeopardy. The increased cost associated with this option would require public notification through an ESD to the ROD. In addition, institutional controls for a longer period of time may be necessary when compared to Option 1a.

Option 1c

Option 1c is very similar to Option 1b, except soil greater than cleanup levels would be removed to the 10 foot depth instead of the 11 foot depth. The 10 foot depth (below natural grade) was specified in the RD/RA-I Work Plan for the other CERCLA sites associated with Operable Unit 8-08. Risk management decisions during the remedial investigation and feasibility study were based on the presence of contaminants in the upper 10 feet of soil.

This option would not require the bottom of the basin (original or elongated) to be excavated. Since the 10 foot depth is used instead of the 11 foot depth (Option 1b), the width of the contamination present along the sides of the basins is estimated to be 15 feet instead of 20 feet (Option 1b). The estimated volume of contaminated soil to be removed from the sides of the basin using this option is 37,800 $ft^3$. Adding the amount expected from the remaining pipe excavation between the security fences and leading to the L-shaped sump (estimated at 10,500 $ft^3$) makes a total amount of 48,300 $ft^3$ of contaminated soil yet to be excavated. This represents approximately 242 additional soft-sided containers (SSCs). To date, 23,300 $ft^3$ of contaminated soil has been excavated. The total amount of contaminated soil to be excavated, including what has already been excavated at NRF-21A, would be 71,600 $ft^3$, which is about 7 times the estimate in the RD/RA-I Work Plan. The total amount of clean and contaminated soil to be excavated with this option is about 150,000 $ft^3$.

Considering the cost per SSC, the 242 SSCs would represent an estimated remaining cost of $1,803,000. The total estimated cost for NRF-21A under this suboption, including work performed to date, is therefore $2,316,000. The original estimated cost for NRF-21A was $705,000. This option requires less soil (contaminated and clean) to be excavated than Options 1a and 1b and therefore is less costly and requires less time to perform. If this option is selected, the time required to complete the effort at NRF-21A would still be extended into next year, which is beyond the RD/RA-I completion goal of November 30, 2001.

The cost variance for this suboption may require public notification per an ESD, since the overall cost for the Operable Unit 8-08 remedial actions will have increased 34% of the cost estimate provided in the ROD. This cost increase does not include the potential additional costs associated with exceeding the current SSC capacity at the S1W Leaching Bed area, as discussed above for suboption 1a, although with Option 1c it is less likely to occur than for Options 1a and 1b.

Once cleanup actions are completed using this option, institutional controls would be required for contamination that exceeds the cleanup levels below the 10 foot depth, as well as the residual contamination within the cleanup goals that remains above the 10 foot depth. Some institutional controls, such as restrictions on soil disturbances below the 10 foot depth (i.e., drilling a well) would be needed well beyond 100 years. The institutional controls for Options 1c would be the same as Option 1b.

The primary advantages of Option 1c compared to Options 1a and 1b are less cost, less time needed to perform the remedial actions, and increased potential that the S1W Leaching Bed area has the necessary capacity. The subcontractor is set up and prepared to excavate to the

required depth. The disadvantages of this option include the total cost relative to Option 2, the fact that this option would not meet the remediation goal for excavation depth in the RD/RA-I Work Plan, and the fact that the schedule for completing NRF-21A would have to be extended beyond November 30, 2001 and could impact the completion date for other CERCLA work, putting the July 31, 2003 completion date for the Phase 1 remedial actions in jeopardy. The increased cost associated with this option may require public notification through an ESD to the ROD. As for Option 1b, institutional controls for a long period of time may be necessary when compared to Option 1a.

Option 1 - Additional

Each of the three suboptions would require excavating in areas where lava rocks and possibly construction debris have been placed in the basins. Exploratory Trench #2 encountered a significant amount of lava rocks, and sorting the lava rocks from the contaminated soil may be difficult. The rock and possibly debris will need to be disposed of after excavation, if it is agglomerated with soil exceeding the cleanup goals. Since some of the rock may be too large for SSCs, this could pose difficulties.

**Option 2**

Option 2 would include securing and filling in the present excavation, removing the 3 foot mounded area, and designing and constructing an engineered native soil cover over the basin. The area to be covered is approximately 340 feet by 80 feet (see Figure 7 for approximate location of cover). An initial assessment shows that a minimal soil cap can cover the majority of the area since contamination is not present until the 8 foot depth in the elongated portion of the basin. Contamination above cleanup levels, as close as 4 feet from the surface, has been detected in the original part of the basin and a slightly thicker cover may be required in this area. It is estimated that a 2-1/2 to 3 foot cover over (above natural grade) the entire basin may be needed. Various items that will be considered during the design of the cover include subsidence, erosion, runoff, infiltration, and biotic intrusion.

An initial cost estimate indicates the cover can be constructed for $250,000 to $300,000. Additional cost will occur to remove the mounded area and to fill in the current excavation, but the costs will be minimal since the controls required for excavating contaminated soil will not be needed. These additional costs are estimated at $50,000. In addition, the remainder of the pipe and associated contaminated soil would still be excavated. Approximately, 53 SSCs are expected from this portion of the remedial actions. Considering the cost per SSC, this would represent an estimated cost of $395,000. As previously stated, $513,000 has been spent on remedial actions at NRF-21A. The total cost for option 2 would therefore be about $1,258,000. The original cost estimate for NRF-21A was $705,000.

This option would have to address concerns that may not be present with the excavation options such as subsidence of the cover, runoff, and infiltration issues. This option would require institutional controls similar to those selected for the covers to be established at the nearby S1W Leaching Beds (NRF-14) and the A1W Leaching Bed (NRF-19). The additional cost should be minimal since the institutional controls will need to be in place for the other areas regardless of the action selected at NRF-21A.

This option has several advantages. The cost associated with this option is less than the options that require excavation, by about $1 to $2.7 million. This option would not affect the July 31, 2003 RD/RA-I completion goal for remedial actions. This option does not require the contaminated soil to be exposed, thereby avoiding the hazards associated with excavations, including the difficulty in removing an unknown amount of lava rock and possibly debris. The

leaching bed area SSC capacity should be adequate for the remainder of the CERCLA remedial actions. This option would require an ESD to the ROD due to the changed scope of the remedial actions.

The Phase II RD/RA Work Plan will include the cover construction at NRF-21A. That Work Plan has a commitment date of April 8, 2002.

**Option 3**

Option 3 would include securing and filling in the present excavation and implementing institutional controls. This option is similar to the no action option required during feasibility studies of CERCLA sites. This option would leave contamination within 10 feet of the surface. Institutional controls would prevent establishing a residence on the property for the length of time needed to allow the radioactivity to decay to less than risk-based concentrations. The initial costs associated with this option are minimal, since only filling in the current excavation is needed. There would be some costs associated with the institutional controls.

The primary advantage of this option is that it is quick to implement and is the cheapest option available. This option would still require an ESD to the ROD since the selected remedial action has changed. Remediation goals in the Phase I Work Plan would not be met with this option. This option does not prevent intrusion into the contaminated soil by biotic means (i.e., plant roots, burrowing animals), since some of the contamination is within 4 to 5 feet of the surface. Since this option was already ruled out during the ROD process, it is included only for completeness.

**Comparison of Options**

During a feasibility study for a CERCLA site, the remedial action options require an evaluation against nine criteria. These criteria are as follows:

(1) Overall Protectiveness of Human Health and Environment
(2) Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)
(3) Long-term Effectiveness and Permanence
(4) Reduction of Toxicity, Mobility, or Volume through Treatment
(5) Short-term Effectiveness
(6) Implementability
(7) Cost
(8) State Acceptance
(9) Community Acceptance

The first seven criteria will be briefly discussed below for each option. The last two criteria can not yet be determined.

Overall Protectiveness of Human Health and Environment

Evaluation of this criterion provides an overall check to assess the degree to which each option accomplishes the overall objectives of the remedial action. This criteria draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs. Failure to meet this criterion eliminates the option from consideration since this criterion is classified as a threshold criterion by the National Contingency Plan. As part of the evaluation of overall protection of human health and the environment, the protectiveness offered by each option is assessed using: (1) the reduction of risk afforded by each option; (2) the effects on workers that would be involved in

implementing each option; (3) the consequences to the potentially affected public; and (4) the potential impact of actions under each option on other environmental media.

Options 1a, 1b, 1c, and 2 meet the overall protectiveness of human health and environment. Similar options were considered during the initial feasibility study for Operable Unit 8-08 and were determined to meet the criteria. A more detailed discussion of the long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs is provided in subsequent sections below. Option 3 does provide protectiveness to human health by providing restrictions on access and land use (institutional controls). However, this option would not prevent intrusion by erosion, burrowing animals, or plant root growth unless additional steps are taken to minimize or eliminate these concerns at the site.

Compliance with ARARs

All the options would meet the ARARs given in the ROD.

Long-term Effectiveness and Permanence

Long-term effectiveness and permanence addresses the level of protection of human health and the environment at the site when the objectives of the remedial action have been met. Options 1a and 2 generally provide the same level of long-term effectiveness and permanence since both would rely on the durability and effectiveness of the designed cover and use of institutional controls, maintenance and monitoring. For Option 1a, this would be at the soil consolidation area (i.e., S1W Leaching Beds) and, for Option 2, this would be at the current basin location. Option 1a does consolidate the soil in one location and it could be argued this option provides better long-term effectiveness and permanence since only one engineered cover would need to be maintained. Options 1b and 1c do provide effectiveness and permanence, but at a lower degree than Options 1a and 2, since some contaminants are left in place greater than 10 or 11 feet deep, without an engineered cover. Options 1b and 1c are more dependent on the proper implementation of institutional controls to prevent intrusion into contaminated soil. Option 3 has the least long-term effectiveness and permanence since all contaminants are left in place and there is a greater risk for intrusion into contaminated soil than with the other options.

Short-term Effectiveness

The short-term effectiveness criterion considers potential impacts to the community, workers, and the environment during performance of the remedial action and also the time required to perform the actions. Option 3 provides the best short-term effectiveness, since there would be no immediate impact to the community, workers, or the environment and it would require the least amount of time to implement. Option 2 provides the next best short-term effectiveness, since no additional contaminated soil would be excavated, which reduces or eliminates potential adverse impacts to the community and workers. This option is also much less physically demanding to the workers than Option 1, which requires excavating in enclosures, wearing additional personnel protective equipment, and more physical labor (hand shoveling, moving tarps, etc.). This option would also require less time to accomplish than any of the excavation options. Options 1 and 2 would have some unavoidable impact on the environment during excavation or cover construction. However, the construction and excavation activities are controllable risks and would not present a significant negative impact on flora and fauna in the area. Option 1c provides better short-term effectiveness than Options 1a and 1b, since it requires less time for excavation and potential exposure to contaminated soil. Likewise, Option 1b provides better short-term effectiveness than Option 1a.

Reduction of Toxicity, Mobility, and Volume through Treatment

None of the options include treatment.

Implementability

This criterion addresses the technical and administrative feasibility for implementation of each option. Technical feasibility includes ability to perform the action including various unknowns, reliability of the technology and potential for technical problems during implementation, ease of undertaking additional future remedial action after actions are taken, and ability to monitor the effectiveness of the remedial action. Administrative feasibility refers to the ability to obtain approvals from other agencies, ability to coordinate with other agencies, and availability of necessary equipment, specialists, specialty services, and materials.

Technically each of the options are relatively easy to implement. The technology and equipment are available for each option. Option 1a would be the most difficult to implement because of the volume of soil to be excavated and the unknowns associated with the fill material (lava rock, debris, etc.). Option 2 would be easier to implement than any of the options requiring excavation. In addition, Option 2 does not require the onsite engineering (i.e., angle of repose, depth of excavation decisions, etc.) that Option 1 requires because of the unknowns associated with Option 1. Although the equipment required for Option 2 is different than Option 1 and is presently not on hand, the equipment is readily available. Option 3 would be the easiest to implement.

Cost

Option 3 is the cheapest. Option 2 is cheaper than the excavation options, of which Option 1c is the least expensive.

Overall Summary

During the feasibility study for OU 8-08, the above criteria were given a comparative ranking to aid in identifying a recommended option. For each category, the options are given a 1 through 5 rating with 1 being the best and 5 being the worst. In some cases, multiple options may have the same rating. For instance, if more than one option provided overall protection of human health and the environment, then they would both have a 1 rating. The table below summarizes the criteria ranking.

| Evaluation Criteria | Option 1a | Option 1b | Option 1c | Option 2 | Option 3 |
|---|---|---|---|---|---|
| Overall Protection of Human Health and the Environment | 1 | 1 | 1 | 1 | 5* |
| Compliance with ARARs | 1 | 1 | 1 | 1 | 1 |
| Long-term Effectiveness and Permanence | 1 | 3 | 3 | 2 | 5 |
| Short-term Effectiveness | 5 | 4 | 3 | 2 | 1 |
| Reduction of Toxicity, Mobility, or Volume through Treatment | 5 | 5 | 5 | 5 | 5 |
| Implementability | 5 | 4 | 3 | 2 | 1 |
| Cost | 5 | 4 | 3 | 2 | 1 |
| Total | 23 | 22 | 19 | 15 | 19 |

* A 5 in this category rules out this option, regardless of overall score.

## Recommendation

NRF recommends implementation of Option 2, subject to consideration of its acceptability to the State, the EPA, and the community. The ranking system described above shows Option 2 (constructing a cover over the NRF-21A basin) as the best option, but there are also several other reasons Option 2 is recommended. Option 2 would allow NRF to concentrate current excavation efforts on the other CERCLA sites and would less likely impact the Phase I completion goal of July 31, 2003. Since two other areas will be covered with engineered caps during the Phase II remedial actions, as specified in the ROD, the engineering and construction effort to include an additional cover is simplified. The construction of a soil cover at NRF-21A would have a defined scope of work, unlike the excavation options where unknowns may be encountered. The exploratory trenches indicated that in at least a few places lava rock was placed in the basin as fill material. This significantly complicates the excavation of the basin. The institutional controls and monitoring requirements for a cover at NRF-21A should be similar to those required at the S1W Leaching Bed area, which is adjacent to NRF-21A, and would minimize any additional costs associated with these post-remedial action tasks.

Additional reasons Option 2 is recommended include:

- Provides significant cost savings when compared to the excavation options.
- Since funding for growth in CERLCA remediation work would come from other planned site remediation, minimizing the CERCLA costs will benefit non-CERCLA remediation at NRF.
- NRF personnel have experience in the design, construction, and contract follow associated with engineered covers. Three landfill areas were successfully covered in recent CERCLA remedial actions.
- This option is more protective to the current subcontractor performing remedial actions, since additional handling of contaminated soil is not required and large excavation pits would not be created.
- The amount of contaminated soil present at NRF-21A has increased significantly from initial assessments. During the ROD process, the decision to excavate the NRF-21A basin was based on the concept that contaminated soil was present in a thin layer at the bottom of the original basin area.

It is worth noting that during the ROD process, two covers were selected over the option of removing all on-site contamination above cleanup goals, partially on the basis of saving about $10 million. By comparison, Option 2 saves $1 to $2.7 million over Option 1 (more if off-NRF soil disposal is considered). On that basis, use of a cover for NRF-21A is consistent with the ROD selection process. Had this information been available at the time of the ROD, constructing a cover over NRF-21A would have been evaluated and possibly selected, particularly considering the proximity to the cover planned for the S1W Leaching Bed area.

The excavation options could include expanding the current S1W leaching bed area for the SSCs to outside the present contamination zone, or shipping soil away from NRF. If shipping were to occur, there would be additional costs above the excavation costs (i.e., additional characterization of soil, transportation and handling, etc.) Option 3 is not considered a viable option since it has the potential to allow intrusion into the contaminated soil by burrowing animals, erosion, or plant growth, which would not be satisfactorily protective of the environment in the long term.

There are some disadvantages of Option 2. This option does not reduce the site footprint of residual contamination as much as Option 1a. The reduction of the footprint was considered an important goal for OU 8-08. However, Option 1a, 1b, or 1c expands the footprint of the S1W

Leaching Bed cover to account for additional SSCs when compared to Option 2. Institutional controls for Option 2 may be required for a longer period of time than the excavation options.

In conclusion, the greatly increased amount of contaminated soil at NRF-21A required a reevaluation of the selected remedial action for this CERCLA site. Options considered included full excavation, partial excavation, construction of a cover, and no additional action. Based on this evaluation, NRF considers Option 2 (construction of a cover) to be the best overall remedial action. This option provides long-term protectiveness of human health and the environment, is easy to implement, costs less than the excavation options, and is more protective to current remedial action subcontractor workers.

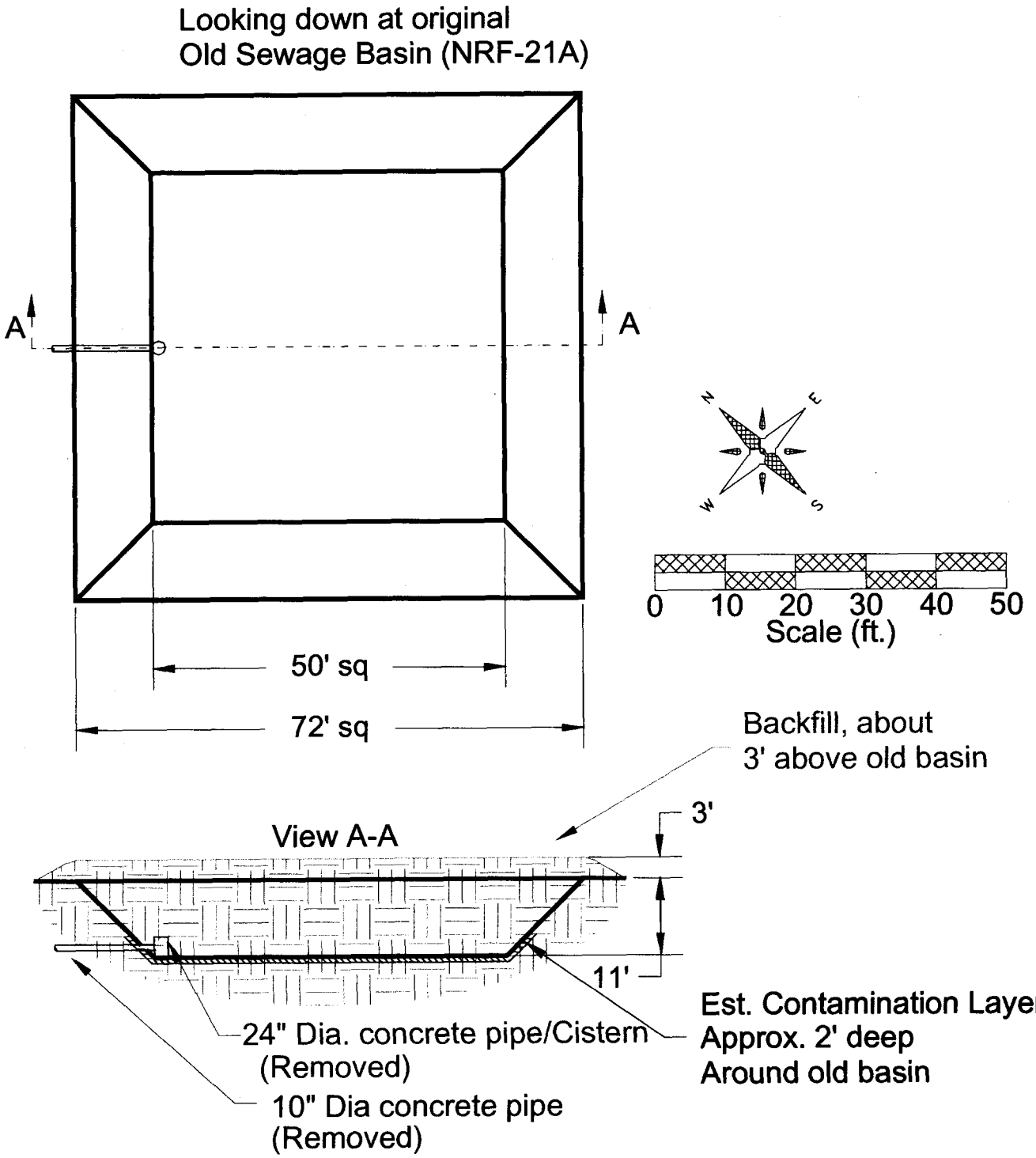


**Figure 1** Original 72' X 72' Sewage Basin

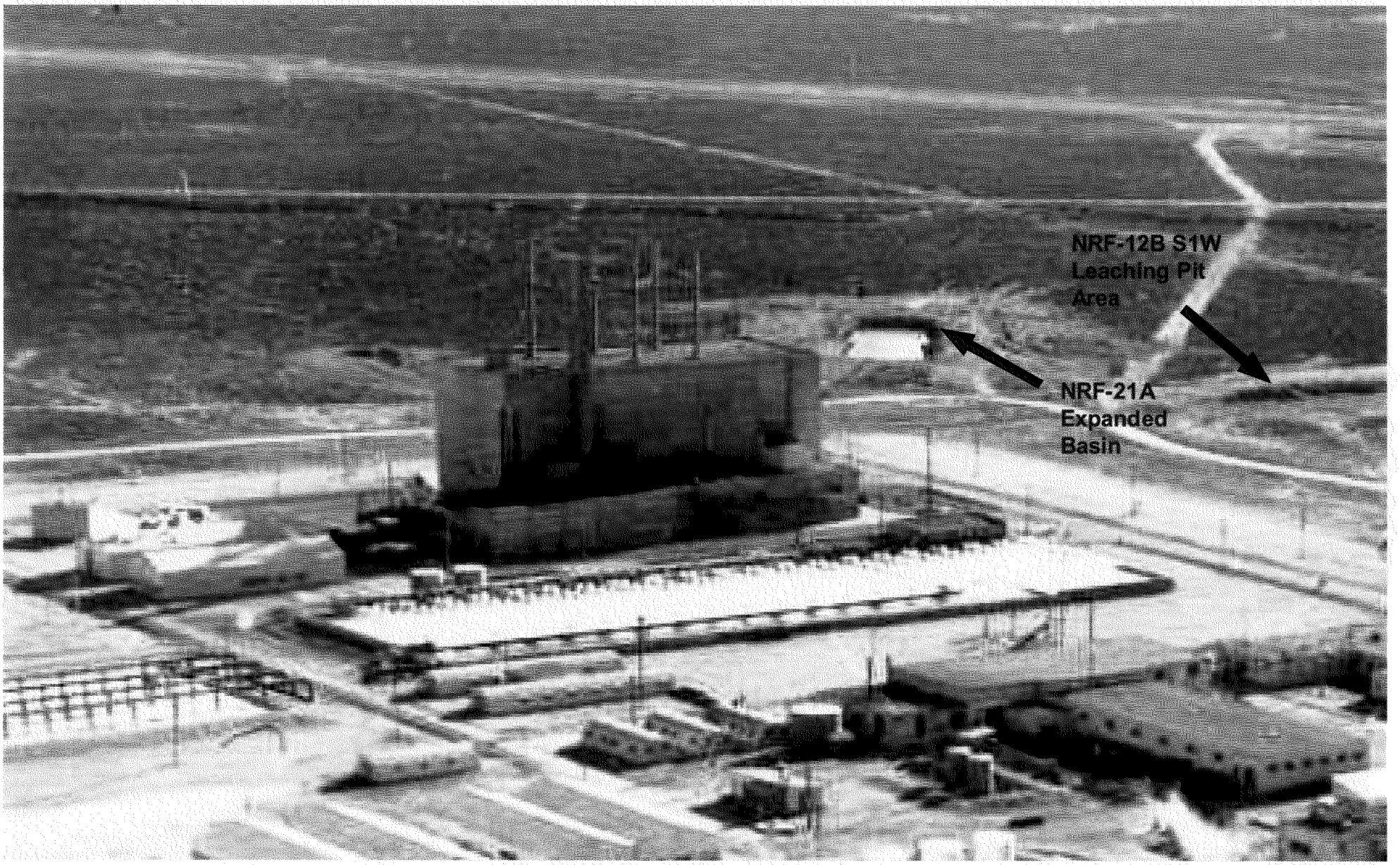


**Figure 2** Photo of Expanded Basin

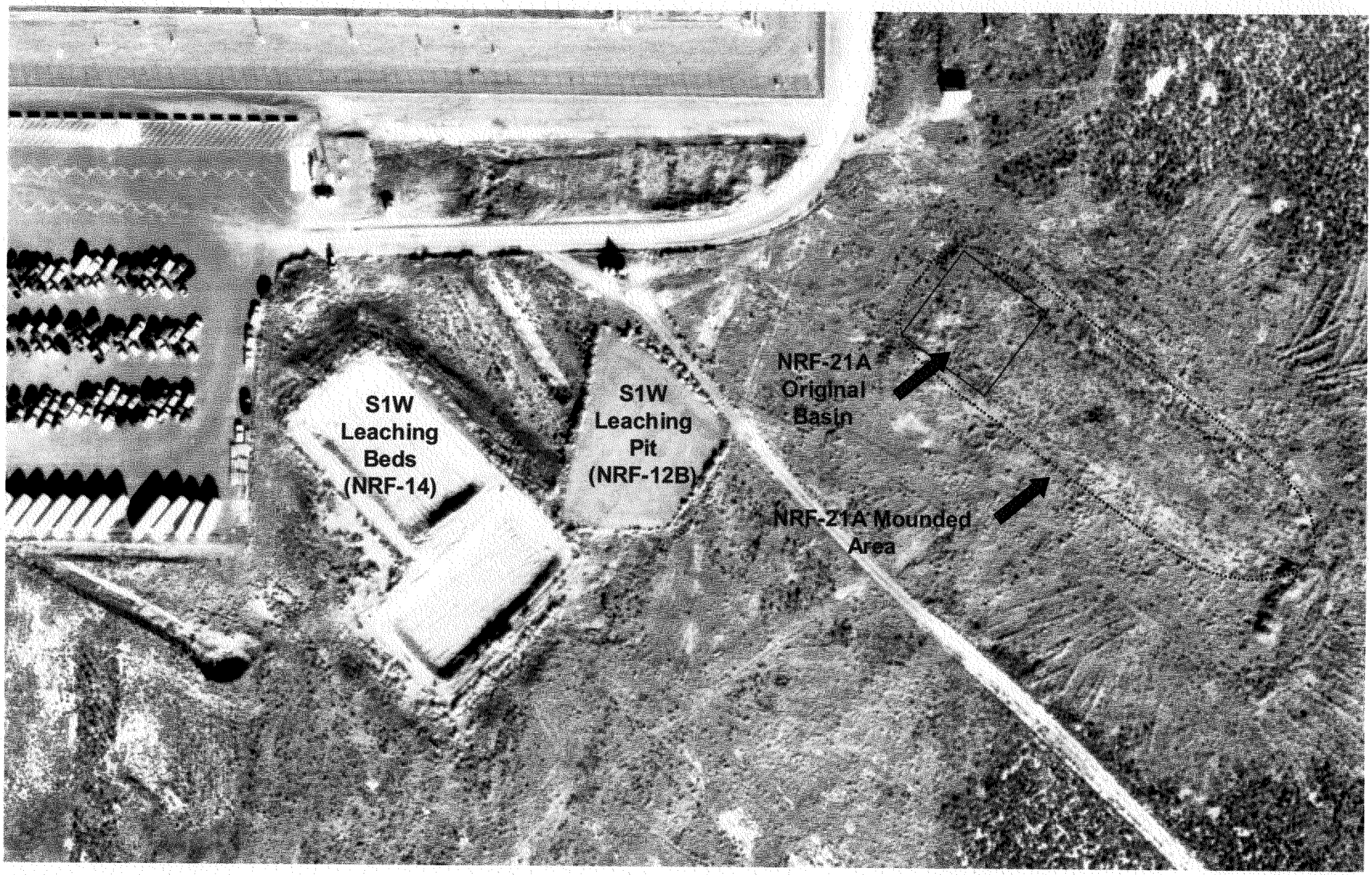


**Figure 3** Overhead Photo of NRF-21A

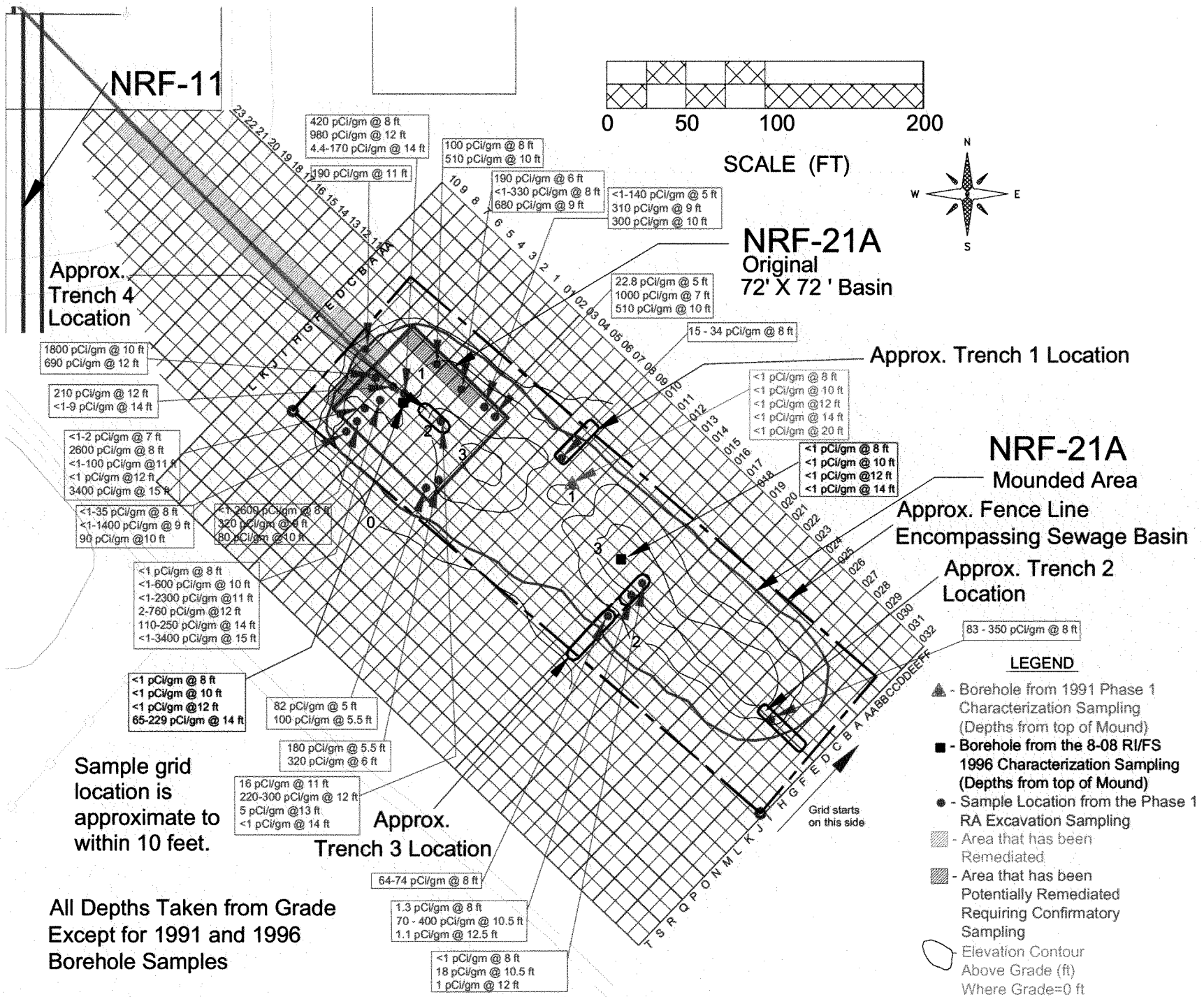


**Figure 4** NRF-21A Sample Locations